

## **REMARKS**

Claims 1-3, 5-6 and 10-21 are pending in the application. Claims 4 and 7-9 have been cancelled from the application and rewritten in independent form in new claims 18-21. No new matter is added to the application by way of these claim amendments.

### **I. TRAVERSE OF THE ANTICIPATION REJECTION**

The examiner rejected claims 1 -3 and 10 -17 under 35 U.S.C. 102(e) in view of Stetson (US Patent 6,701,170). Claims 1-3 and 10-17 are not anticipated because Stetson fails to disclose the unique blind source separation many features of the rejected independent claims. In particular Stetson fails to disclose the features of any of the preamble and paragraphs (a), (b) and (c) of independent claim 1 and similar features of apparatus and software claims 14 and 16. Additionally, Stetson fails to disclose features of many dependent claims.

#### **A. Independent Claims 1, 14 And 16 Are Novel**

Stetson discloses conventional blind source separation, i.e. taking signal mixtures and relying on their statistical independence to recover the original signals prior to mixing. (See Stetson at col. 5 lines 18-36 & col.7 lines 32-67). Indeed, blind source separation of the type disclosed in Stetson has been known for over fifteen years. (See USPA 2005/0105644 at paragraphs [0002] to [0041] provide a review of blind source separation prior art back to 1993).

Applicants' claimed invention does not use conventional blind source separation of signal mixtures. This is because an objective of Applicant's invention is not to recover original signals prior to mixing. Instead the objective is to recover signal modulation envelopes and/or separated cyclets, i.e. attributes and/or parts of signals. In order to accomplish this, Applicants' claimed invention processes a matrix with rows corresponding to cyclet length which is not the same as processing rows which are signal mixtures unrelated to cyclet length as in Stetson.

Turning now to the examiner's specific claim objections, the Examiner states that Stetson discloses a method and computer apparatus for separating a plurality of source signals from a composite signal in accordance with the limitations of claims 1, 14 and 16. Specifically, the Examiner indicates that Stetson (Fig. 1 and Fig. 3) discloses claim 1(a) at Col. 5, lines 20 – 26, claim 1(b) at Col. 6, lines 64 - 67 and claim 1(c) at Col. 7, lines 32 -67.

This rejection is respectfully traversed because the indicated passages of Stetson do not in fact make the disclosures attributed to them by the Examiner. To be more specific, Col. 5, lines 20 – 26 actually states:

“Blind Source Separation refers to the separation of signals given only linear combinations of those signals, such that:  $x(t) = As(t)$ ”, where  $x(t)$  is a matrix of a set of observed signals (mixed signals),  $x_1(t) \dots \dots x_n(t)$ ”.

Stetson’s  $x(t)$  is therefore a matrix of signals  $x_1(t) \dots \dots x_n(t)$ . This is quite different to Applicants’ matrix  $X$  claimed in claim 1(a), because  $X$  is a matrix having rows each of which corresponds to a length of time associated with a signal cyclet. A cyclet is a part of a signal which repeats to form the signal. (See Applicants’ Fig. 2a, showing cyclets 28a-28d with period  $p$ ). A row of  $X$  therefore corresponds to a part of a signal not the whole signal, unlike Stetson’s rows  $x_1(t)$  etc. of matrix  $x(t)$ .

Another feature of the claim 1 invention not disclosed in Stetson is found in the claim preamble which limits Applicants’ source signals to having similar or equal periods or cyclet length. This feature is not found in Stetson and would not apply to Stetson’s signals  $x_1(t) \dots \dots x_n(t)$  because Stetson’s signals are quite different to one another, such as a plethysmographic signal and a motion artifact. (See e.g. Stetson at col. 4 lines 18-22). Consequently Stetson fails to disclose claim 1(a).

Stetson also fails to disclose the feature of independent claim 1(b). The portion of Stetson relied upon for disclosing this teaching - col. 6, lines 64 – 67 - actually states:

“In one embodiment, the Singular Value Decomposition algorithm is used to obtain the principal components. In one alternate embodiment, the data are multiplied by the inverse of the” (at the top of Col. 7 the sentence continues “square root of the covariance matrix”).

But, as has been noted above, Stetson Col. 6, lines 64 – 67 relates to processing a matrix  $x(t)$  of signals  $x_1(t) \dots \dots x_n(t)$ , not a matrix  $X$  with rows which are parts of signals of cyclet length to which claim 1(b) applies. Consequently Stetson fails to disclose claim 1(b) for at least this reason.

Stetson further fails to disclose the feature of independent claim 1(c). The excerpt of Stetson cited by the examiner for disclosing this feature of claim 1 - col. 7, lines 32 -67 - discloses that, subsequent to decorrelating the data, the principal components are processed to

obtain a plurality of independent components, a matrix of the plurality of signals corresponding to a product of a matrix of the plurality of independent components and a matrix of mixing coefficients. Stetson at col. 8, lines 4-7 discloses processing to recover the plethysmographic signal, i.e. all of this signal not an attribute such as its envelope or a part of it such as a cyclet. What is disclosed at Stetson col. 7, lines 32 -67 is therefore quite different to claim 1(c), because claim 1(c) specifies ICA to obtain separated signal modulation envelopes and/or separated signal cyclets.

Because Stetson fails to disclose the preamble and paragraphs (a), (b) and (c) of claim 1, Applicants' invention as set forth in independent claim 1 is novel over Stetson. Independent claims 14 and 16 are novel for similar reasons. Finally, dependent claims 2, 3, 5, 6 and 10-13 are likewise novel over Stetson at least because they depend directly or indirectly from claim 1

#### **B. Many Dependent Claims Are Independently Novel**

Claim 2 is independently novel over Stetson. Regarding claim 2, the Examiner states that Stetson discloses a method according to claim 1 including the step of estimating source signal period  $p$  by synchronous averaging of the composite signal and cites Stetson at col. 5, lines 30 - 35 for supplying this element. The Examiner's rejection is traversed at least because Stetson does not disclose estimating source signal period  $p$  at the cited passage. Instead Stetson col. 5, lines 30 -35 discloses a parameter  $p(s)$  which is a probability distribution function. This is seen clearly at Stetson col. 5, line 36 which states "where  $p(s)$  is the probability distribution function of  $s$ ". The equation for  $p(s)$  in Col. 5, line 33 is the familiar criterion for statistical independence of signals, i.e. that one can factorise the probability distribution function of  $s$  into a product of individual probability distribution functions of signals  $s_1$  to  $s_m$  in  $s$ . Clearly, a probability distribution function is completely different to a source signal period. The mere fact that Stetson uses the letter  $p$  to designate such a function does not make the disclosure anticipatory.

Claim 3 is also independently novel over Stetson. In claim 3 the "decomposition" relates to the matrix  $X$  with rows of cyclet length, which Stetson does not disclose for reasons given in relation to claim 1 above. Moreover, Stetson does not disclose obtaining at least one of a matrix which contains estimated separated signal modulation envelopes and a matrix which contains estimated separated cyclets. The Examiner cites Stetson at col. 6, lines 64 - 67 and col. 7, lines 32 – 67 for disclosing this feature. However, neither cited Stetson extract mentions a matrix with

rows of cyclet length, a matrix of signal modulation envelopes or a matrix of separated cyclets. For each of the reasons, claim 3 is independently novel over Stetson.

Claims 5 and 6 are further independently novel because Stetson does not disclose the following claim features:

- (a) signal modulation envelopes, or
- (b) cyclets, or
- (c) statistical independence of signal modulation envelopes or cyclets, or
- (d) performing ICA in step (c) on a singular vector matrix  $U$  to obtain an independent component matrix  $UR_2^T$  containing estimated separated signal envelopes and a matrix  $R_2\lambda V$  containing estimated separated cyclets

The Examiner cites Stetson col. 7, lines 32 -67 in support of the novelty rejection of claim 5. This Stetson extract, however, does not mention signal modulation envelopes, cyclets or any of the other items referred to in the preceding paragraph. The remarks given above in relation to claim 5 also apply to claim 6 with signal envelopes exchanged for cyclets and vice versa. Claims 5 and 6 are independently novel over Stetson for at least each of these reasons.

Claim 10 is independently novel in view of Stetson. The Examiner states that Stetson discloses the composite signal being detected by a single sensor, citing Fig. 1 and 110. In fact from the text the whole sensor is referenced 100 and the light source is 110. However, in Stetson Figure 1 there is a drawing error and both are shown as 110. In conventional blind source separation (see Stetson Col. 5 lines 18-30), it is a fundamental requirement that there are at least as many sensors as there are signals to be separated. Stetson in effect has two sensors, because he detects two signals at different wavelengths – see Col. 6 lines 35-51 and Fig. 3 in which plots 310 and 320 for two wavelengths appear. Consequently Stetson does not disclose the subject matter of claim 10 and claim 10 independently novel for at least this reason.

Claims 11 and 12 are independently novel because Stetson does not disclose the matrix  $X$  of cyclet length rows for reasons given above in connection with claim 1.

Claim 13 is also independently novel. Regarding claim 13, Stetson does not disclose the at least one of estimated separated signal modulation envelopes and estimated separated signal cyclets, nor their analysis for indications as to the condition of respective apparatus sources. The Examiner cites Fig. 1 and col. 4, lines 33 -60 of Stetson for disclosing this claim element.

However, the cited extract is silent about modulation envelopes, signal cyclets or their analysis and claim 10 is believed to be novel over Stetson for at least this reason.

### C. Independent Claims 15 And 17 Are Novel

The Examiner's rejection of claims 15 and 17 for lack of novelty in view of Stetson is traversed. Specifically, the following features of the rejected claims are not identically disclosed in Stetson:

The preambles of claims 15 and 17 recite "the source signals having periodicities similar or equal to  $p$ " which is not disclosed in Stetson. Stetson's Fig. 3 does not show source signals but instead signal mixtures into which the source signals have become mixed and from which it is desired to separate them. (See also the Examiner's cited col. 6, lines 45-50 at 45-47, which states that graphs 310 and 320 are photocurrent – i.e. signals generated by a detector.).

Features of part (a) of claims 15 and 17 are not disclosed by Stetson. The Examiner's reliance upon Stetson col. 5, lines 20 – 26 for disclosing this claim feature is misplaced. The cited Stetson passage discloses only conventional blind source separation with signals of unspecified length. The passage does not disclose partitioning the composite signal into matrices  $X$  having rows corresponding to signal cyclets.

Stetson also fails to disclose features of paragraph (b) of claims 15 and 17. The portion of Stetson the Examiner cited for disclosing this feature of claims 15 and 17 - col. 6, lines 64 – 67 - actually discloses a singular value decomposition but not an SVD of a matrix  $X$  having rows corresponding to signal cyclets as claimed.

Stetson further fails to disclose features of paragraph (c) of claims 15 and 17. As previously stated in connection with claim 2 above, Stetson Col. 5, lines 30 -35 does not relate to estimating a true period  $p$  of the source signals, nor doing so from an average of data within rows of partition matrices  $X$ . Instead Stetson Col. 5, lines 30 -35 discloses a parameter  $p(s)$  which is a probability distribution function. A probability distribution function is completely different to a source signal period.

Finally, Stetson fails to disclose certain features of paragraph (d) of claims 15 and 17. The Examiner's cited Col. 7, lines 32 -67 for disclosing independent component analysis (ICA, see e.g. line 33). However, the cited portion of Stetson fails to disclose ICA of one of the singular vector matrices  $U$ ,  $V$  generated by SVD from the matrix  $X$  having rows corresponding to signal cyclets and partitioned in accordance with the estimated period  $p$ . Moreover, there is no disclosure in the cited excerpt of obtaining an independent component matrix  $UR_2^T$ ,  $R_1^TV$  and an associated component matrix  $R_2\lambda V$ ,  $U\lambda R_1$  one of which  $UR_2^T$ ,  $U\lambda R_1$  contains estimated separated signal modulation envelopes and the other  $R_2\lambda V$ ,  $R_1^TV$  contains estimated separated cyclets

## **II. THE ALLOWABLE CLAIMS**

The examiner indicated in the Office Action that claims 4 and 7-9 would be allowable if rewritten in independent form. Claims 4 and 7 -9 have been cancelled from the application and presented in independent form as new claims 18-21.

## **CONCLUSION**

Claims 1-3, 5-6 and 10-21 are pending in the application and are believed to be patentable for the reasons recited above. Favorable reconsideration and allowance of all pending application claims is courteously solicited.

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